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By Hand

Robert James
Ass't for Microwave Services
Wireless Telecommunications Bureau
Federal Communications Commission
2025 M Street, NW, Room 8010
Washington, DC 20554

Re: CellularVision USA, Inc. Report on Potential Use of 31.0-31.3 GHz ("31 GHz")
<u>CC Docket No. 92-297</u>

Dear Bob:

As a follow-up to your request Tuesday regarding the viability of LMDS utilizing 150 MHz in the 31.0-31.3 GHz band ("31 GHz") for return links, enclosed is a preliminary assessment prepared by CellularVision USA, Inc.'s ("CVUS") technical personnel analyzing the severe technical, economic and "time-to-market" implications that would result if LMDS operators were forced to use the 31 GHz spectrum for return links.

Should you have any questions regarding this preliminary report, or require additional information on the impossibility of LMDS utilizing the 31 GHz band, please do not hesitate to contact us.

Sincerely,

Michael R. Gardner
Charles R. Milkis
Counsel for CellularVision USA, Inc.

Enclosures

cc William F. Caton

Assessment of the Impact of a 31 GHz Spectrum Allocation on LMDS

Prepared by CellularVision USA, Inc.

March 29, 1996

As requested by the Commission, CellularVision USA, Inc. ("CVUS") has examined the potential impact of a move to the 31 GHz band on LMDS operations. It is the understanding of CVUS that the 31 GHz spectrum has been given consideration as an alternative to the 150 MHz or 135 MHz of LMDS spectrum in the 29.1 GHz area. Specifically, it is our understanding that the alternative under consideration by the Commission is 150 MHz of spectrum in the 31.0 - 31.3 GHz band.

In short, the 31 GHz spectrum is not a viable option for LMDS. Such a move would result in direct, adverse impact on LMDS technical performance, economic viability and time-to-market. Obviously, these issues are critical. There are numerous reasons for this conclusion, each of which is delineated below.

Frequency Span Resulting from the 31 GHz Plan is Impractically Large

An obvious and fundamental problem with the proposal to move 150 MHz of spectrum to the 31 GHz band is the total frequency span of the LMDS spectrum under such a situation. For example, even with the best-case assumption, under which the 150 MHz of LMDS spectrum would be placed in the 31.0 - 31.15 GHz band, the span of the LMDS spectrum would be from 27.5 GHz to 31.15 GHz, which is a total span of 3.65 GHz. In contrast, the frequency span of the LMDS spectrum under option 4' is only 1.875 GHz. Thus, the *minimum* frequency span associated with the 31 GHz proposal is about *two times* the frequency span of LMDS under Option 4'.

The operational impact of this large frequency span on LMDS is both direct and severe.

A Single Subscriber Antenna is Not Practical with the 31 GHz Plan

While CVUS believes that the low-cost planar array antenna technology now employed in the LMDS can be "stretched" to cover the 1.875 GHz span of Option 4', we are equally convinced that the technology will *not* support operation over the (minimum) 3.65 GHz span resulting from any 31 GHz proposal. This bandwidth is simply too large. Any attempt to employ a single antenna would result in failure to meet current performance criteria. To meet the gain objective, the antenna would have to be larger due to loss considerations. Then, the beamwidth would be narrower and this would cause operational pointing problems. If we wish to maintain the current beamwidth to minimize pointing problems, the gain would be degraded, causing a reduction in the subscriber unit figure of merit. This would result in smaller cells, driving up overall system cost. Additionally, ripple and VSWR problems will be more severe, and sidelobe performance will be degraded.

These problems are inescapable. If the antenna is designed for optimal performance at some point within this large frequency span, its performance will be severely degraded elsewhere. For example, if the antenna design is tailored for a specific gain/beamwidth characteristic in the 27.5 - 28.35 GHz band, the gain/beamwidth performance will be severely degraded in the 31.0 - 31.15 GHz band.

This may render the 150 MHz of spectrum above 31 GHz unusable with a single antenna design. If the 150 MHz is used for hub-to-subscriber transmission, the subscriber antenna will expose the LMDS receiver to a degraded signal level due to reduced receive antenna gain and to multipath susceptibility due to degraded antenna sidelobe suppression. If the 150 MHz is used for subscriber-to-hub transmission, the same antenna degradations will cause a reduction in return link performance (measured either by margin or throughput) and a degradation in frequency-reuse performance in the LMDS cellular system due to higher subscriber emissions in the sidelobes. This latter factor would also threaten the viability of any secondary use of the band.

<u>The Dual Antenna Approach would Double the Cost of the Subscriber Antenna</u>

Since a single antenna is not practical, the only alternative would be to use a dual-antenna scheme for the subscriber station. This would employ one antenna for the 27.5 - 28.35 GHz band and another for the 31.0 - 31.15 GHz band. This would result in a doubling of the cost of the subscriber antenna subsystem for the LMDS system. Since the overall LMDS system cost is extremely sensitive to the subscriber CPE cost, this would be disastrous to the attractiveness of LMDS as a low-cost alternative for the consumer.

<u>The 31 GHz Proposal Would Require Two Downconverters -- This Also Doubles Cost</u>

In the current CVUS system, the entire 1000 MHz of LMDS spectrum is downconverted in a single block and applied to the subscriber set-top receiver at an appropriate intermediate frequency. This is advantageous because it allows the use of widely-available, mass-produced set-top receivers -- a critical component of the attractive cost of LMDS.

If the 31 GHz proposal is adopted, we will have to use a twin downconversion scheme at the subscriber station to separately downconvert the two bands (each of which is received on a separate antenna). Use of a non-standard set-top receiver is an unacceptable proposition. The cost of this downconversion scheme would be about twice the current cost -- just like the antenna.

It is conceivable that a single downconverter could be used, but its parts count, taking into consideration the necessary dual millimeter-wave oscillators or a second IF stage with a synthesized, switchable second local oscillator along with the necessary control functions, would be approximately as high as that of the twin downconversion scheme. Consequently, the cost impact would be similar as well -- about double.

Unfortunately, this equally-cost-prohibitive, single-downconverter scheme is not a viable alternative regardless of cost since multiple television households are an increasingly large share of the market and MDUs are primary targets for LMDS service. These types of LMDS subscriber installations, which share the characteristic of multiple viewers which demand different programming, cannot be served by a single downconverter which must select between the two LMDS bands under a 31 GHz proposal. Even if these considerations were ignored, the subscriber receiver would have to be significantly modified to accommodate the single-downconverter approach. For example, the receiver would have to provide a control signal to the downconverter to select between the multiple bands for signal application to the receiver -- this function is not provided in today's mass-market, inexpensive subscriber receivers.

Subscriber Transmitter Cost Would be Higher Under Any 31 GHz Proposal

If two-way LMDS service is provided, the cost of the subscriber transmitter under Option 4' would be lower than under any 31 GHz proposal. In either case, a natural place to provision the subscriber-to-hub communications in the LMDS spectrum would be in the smaller subband (29.24 - 29.375 GHz in the case of Option 4' or 31.0 - 31.15 GHz under a possible 31 GHz proposal). Aside from the need for a separate antenna as discussed above, the cost of implementing the subscriber transmitter unit would be higher at 31 GHz than at 29 GHz. While the increase in cost may be modest (say 25%), this is nonetheless significant since it is a cost increase in the subscriber CPE -- the overall LMDS system cost is very sensitive to subscriber equipment cost.

Current Hub Transmitter Technology Will Not Support Operations Over the 3.65 GHz Frequency Span

The 31 GHz spectrum is so far above the "other" LMDS band (27.5 - 28.35 GHz) that the current hub transmitter technology could not be used. The current hub transmission approach employs only one block-conversion transmitter and transmit antenna system to deliver all of the LMDS video programming to the subscriber. Under any 31 GHz proposal, an additional transmitter (for a total of two) would have to be used at each hub transmission location.

The use of a single hub antenna across the entire 3.65 GHz band would reduce the cell size due to pattern problems across such a large bandwidth. A possible alternative to the dual transmitter/antenna approach involves the use of a transmit diplexer to allow the use of two antennas with only one transmitter. Unfortunately, the transmitter tube performance would be degraded over the large frequency span -- this would compromise power per carrier resulting in reduced cell size and, consequently, a drastic increase in overall LMDS system cost since more cells would be needed to serve a given area. Also, intermodulation products produced by the tube in the vast span between the two LMDS subbands would make compliance with any out-of-band emission limits extremely difficult.

As a result of these technical problems, two transmitters would be required if the hub transmissions are to cover 1000 MHz of bandwidth, and this obviously results in two times the cost. Consequently, it appears none of the available options for the hub transmitter architecture is economically attractive -- today's combination of low cost and good performance cannot be realized under the 31 GHz scenario.

Propagation Problems at 31 GHz Push Toward the Unviability Problems at 40 GHz

The myriad problems with the concept of LMDS at 40 GHz should be easily recalled. LMDS is not viable in the 40 GHz band. One of the issues at 40 GHz is rain attenuation. Likewise, LMDS operations at 31 GHz would be subject to more severe rain-induced degradation than at 27.5 GHz, although 31 GHz is not as bad as 40 GHz. When the frequency span becomes as large as that required under any 31 GHz proposal (e.g., 3.65 GHz), large path loss gradients accrue over the large span during rain events. This would cause a frequency-selective outage phenomenon during peak rain rate periods because the higher frequency links would fail while the lower frequency links would survive. This is untenable.

As an example, in even a moderate rain rate area (New York), the specific path loss due to rain for 99.9% availability would increase from about 2.5 dB/km at 27.5 GHz to about 3.0 dB/km at 31.15 GHz. This would produce a path loss difference of 2.4 dB over a 4.8 kilometer path. Worse yet, in Miami, the specific path loss for the same availability would increase from about 6.0 dB/km at 27.5 GHz to 7.2 dB/km at 31.15 GHz, producing a path loss difference of 3.2 dB across the band for the cell radius of 2.7 kilometers. This problem could make the upper 150 MHz of LMDS spectrum in the 31 GHz band unusable in much of the cell area. Moreover, this problem is reinforced by equipment performance degradation at these higher frequencies.

Restrictions and Service Rules for the 31 GHz Spectrum Are Not Defined

It appears that the Commission's 31 GHz proposal is only in the formative stages. LMDS proponents have experienced significant reduction in spectrum allocated for the service in various band plan proposals and also have experienced varying proposed sets of operational restrictions on the use of certain portions of the spectrum. It is the understanding of CVUS that any potential use of the 31 GHz spectrum by LMDS would require another Notice of Proposed Rulemaking along with the mandated comment periods. Even if this lengthy regulatory path were successfully traversed, it would undoubtedly add months to a process which appeared to be approaching closure. This is a critical concern since time-to-market issues have a direct impact on the economic value of any LMDS system or proposed system.

Further, with the restrictions and service rules undefined for any potential LMDS operations in the 31 GHz band, an unacceptably large risk exists that the 150 MHz of spectrum in the 31 GHz band could be of little utility in practical LMDS operations -- further damaging the economic potential and consumer attractiveness of LMDS. Obviously, CVUS cannot comment specifically on the technical impact of proposed service rules for 31 GHz LMDS since they are not defined.

In summary, it is our conclusion that the 31 GHz proposition is not a viable alternative for LMDS.